February Science Team Meeting
Early L1b Evaluation

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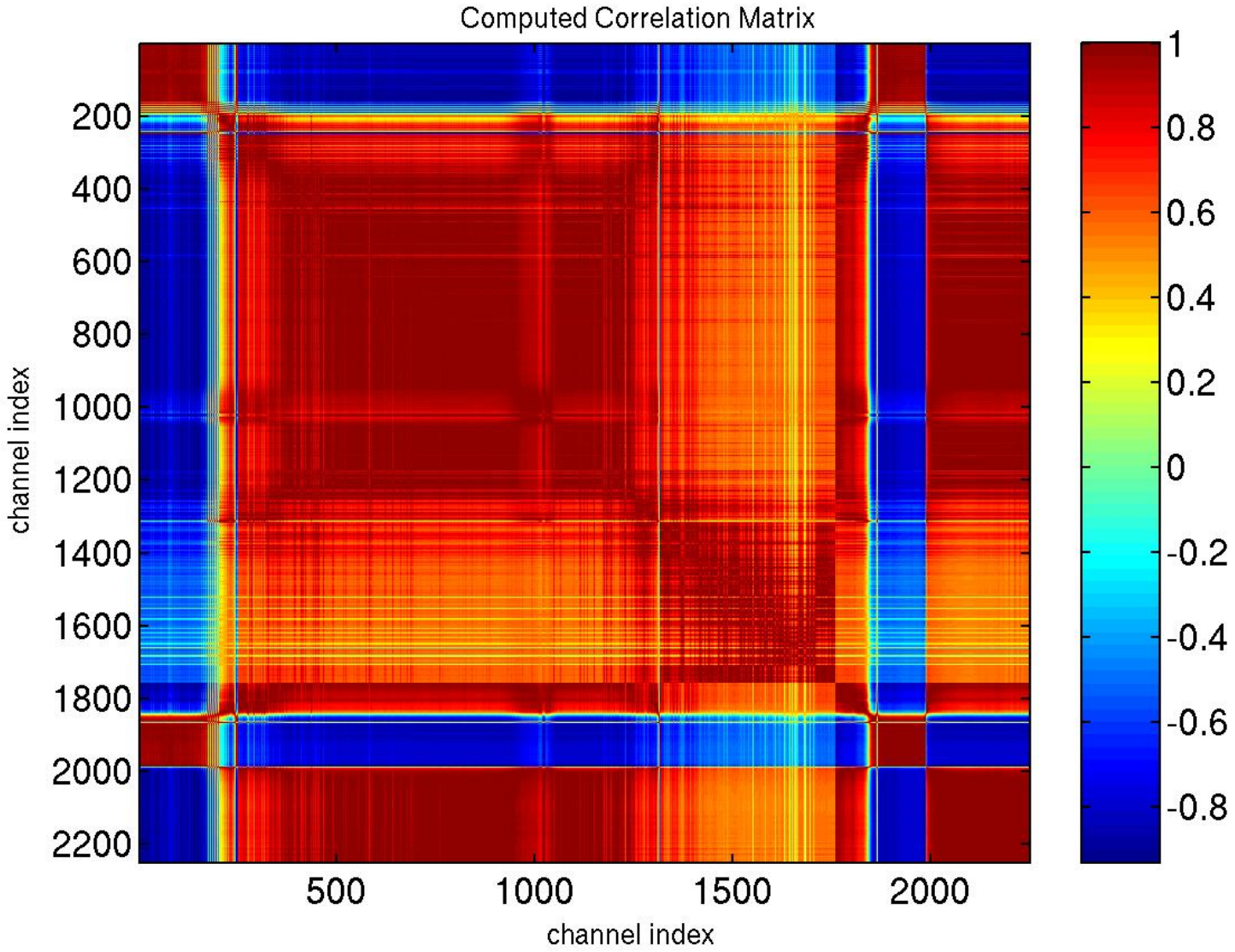
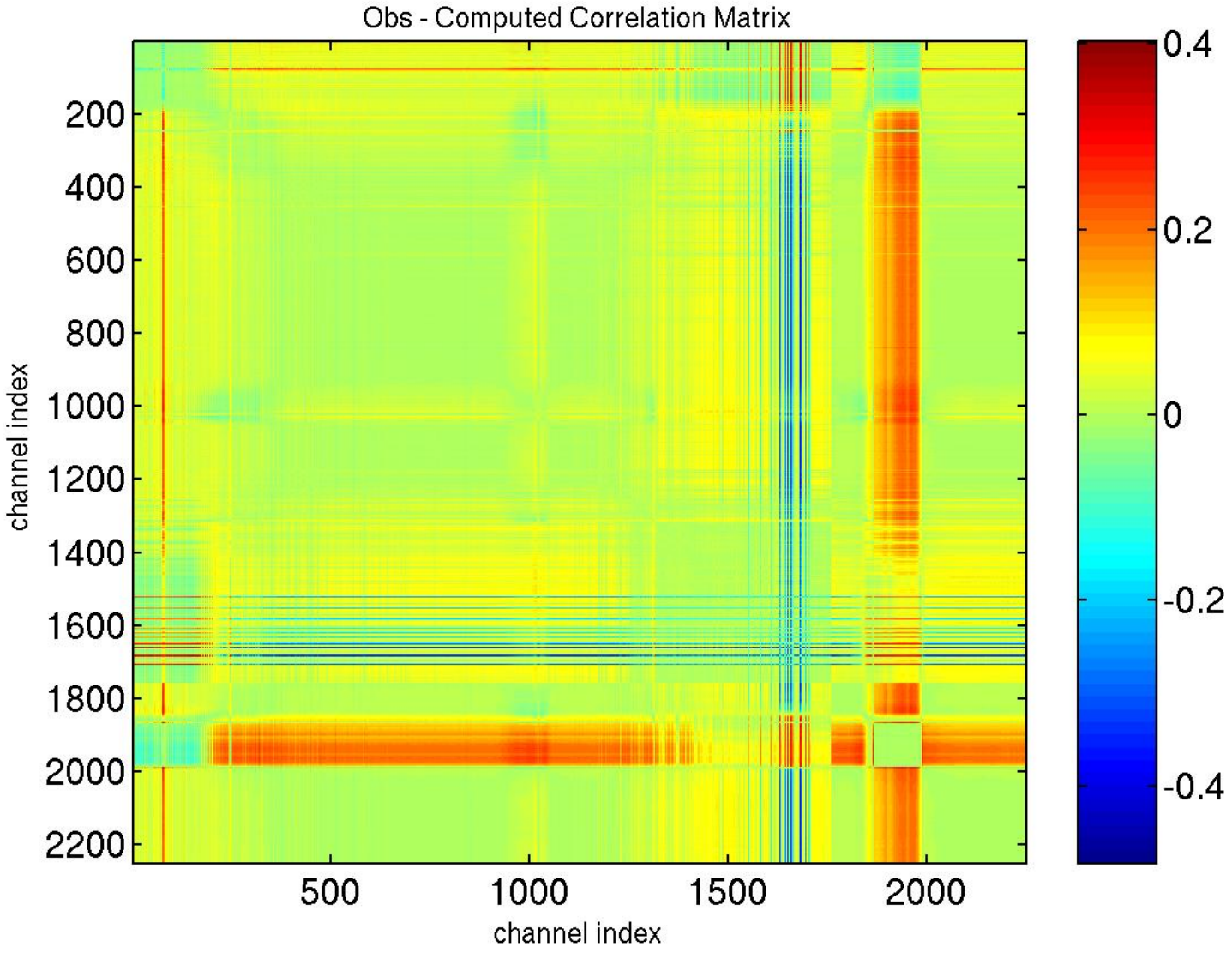
Overview

- Concentrate on model (ECMWF) data for “early” evaluation
- As sonde/lidar results come in, will evaluate as well
- Used V2.2.0 granules, matchup-files for this work (night/ocean)
- Assume do not know frequency scale
- Used our own clear flags (absolute and differential window B(T) tests, using model/obs SST). Haven’t implemented TMI SST yet.
- To lower volume and to improve detection of clear, only used warmest FOV per golfball.
- Main new software: kCARTA wrapper and large scale convolutions
- Can run ~ 1000+ AIRS profiles/day with kCARTA
- Software view of activity: produce RTP files
- Developed file organization scheme for these analyses
- Probably pre-process at JPL to produce RTP files with clear FOVS (need ECMWF files at TLSFC soon to test).

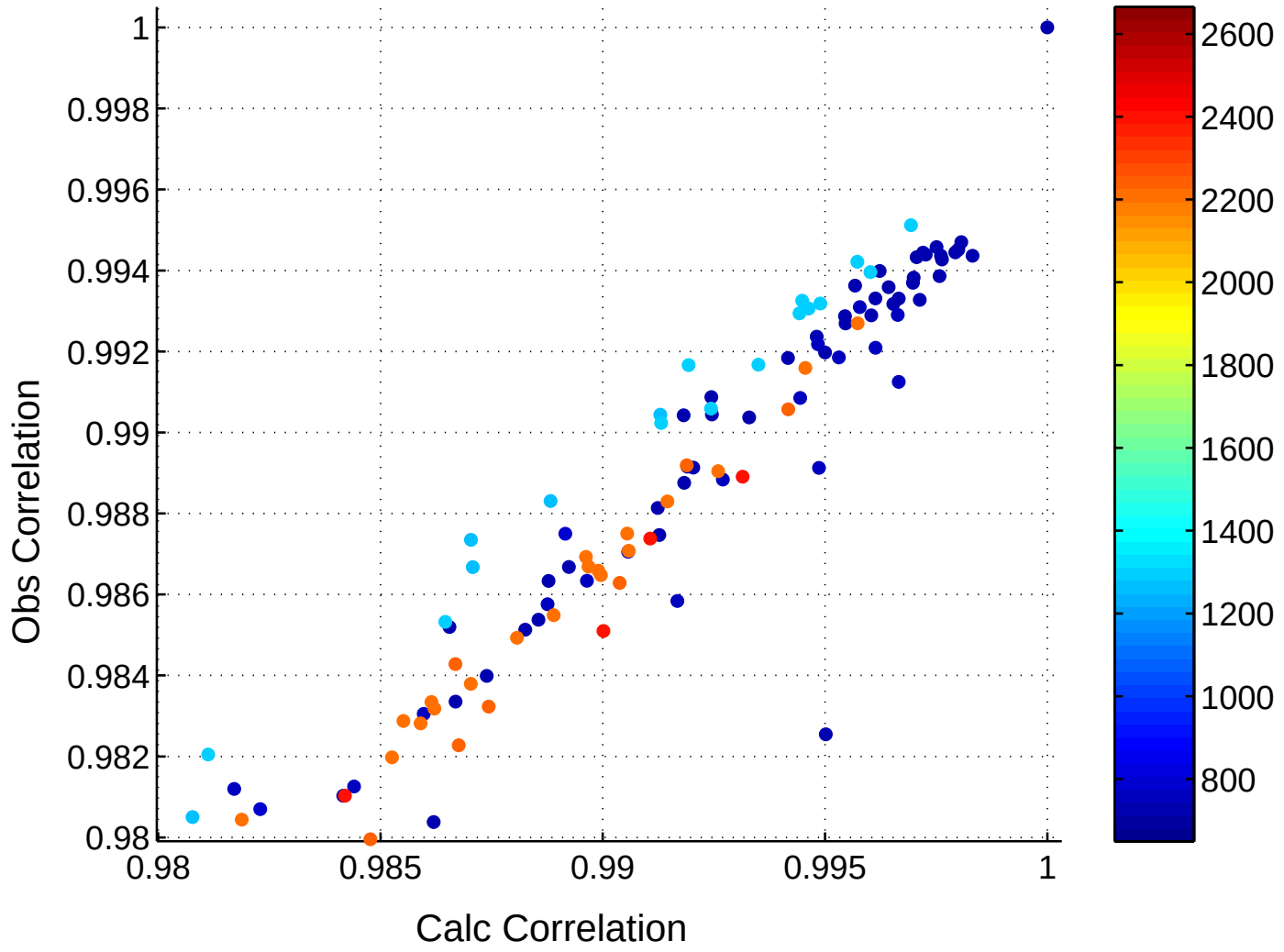
Radiance Covariance Analysis

- Determine if observed channel correlations match computed correlations
- Didn't add noise to computed correlations for present simulation (reduced agreement between obs and calc correlation)
- Use to identify significant outliers
- If matchup files are available, can generate about 1 correlation matrix/day with kCARTA, assuming $\sim$ 500-1000 clear FOVS over ocean/night.
- Limited utility for water channels using model data
- Assume others will work on this once fast model at correct frequencies is available.
- Software pretty much complete. Difficult to test with present simulations.


Computed Correlation Matrix
channel index
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
500
1000
1500
2000
channel index
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8


Obs - Computed Correlation Matrix
channel index
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
500
1000
1500
2000
channel index
0.4
0.2
0
-0.2
-0.4

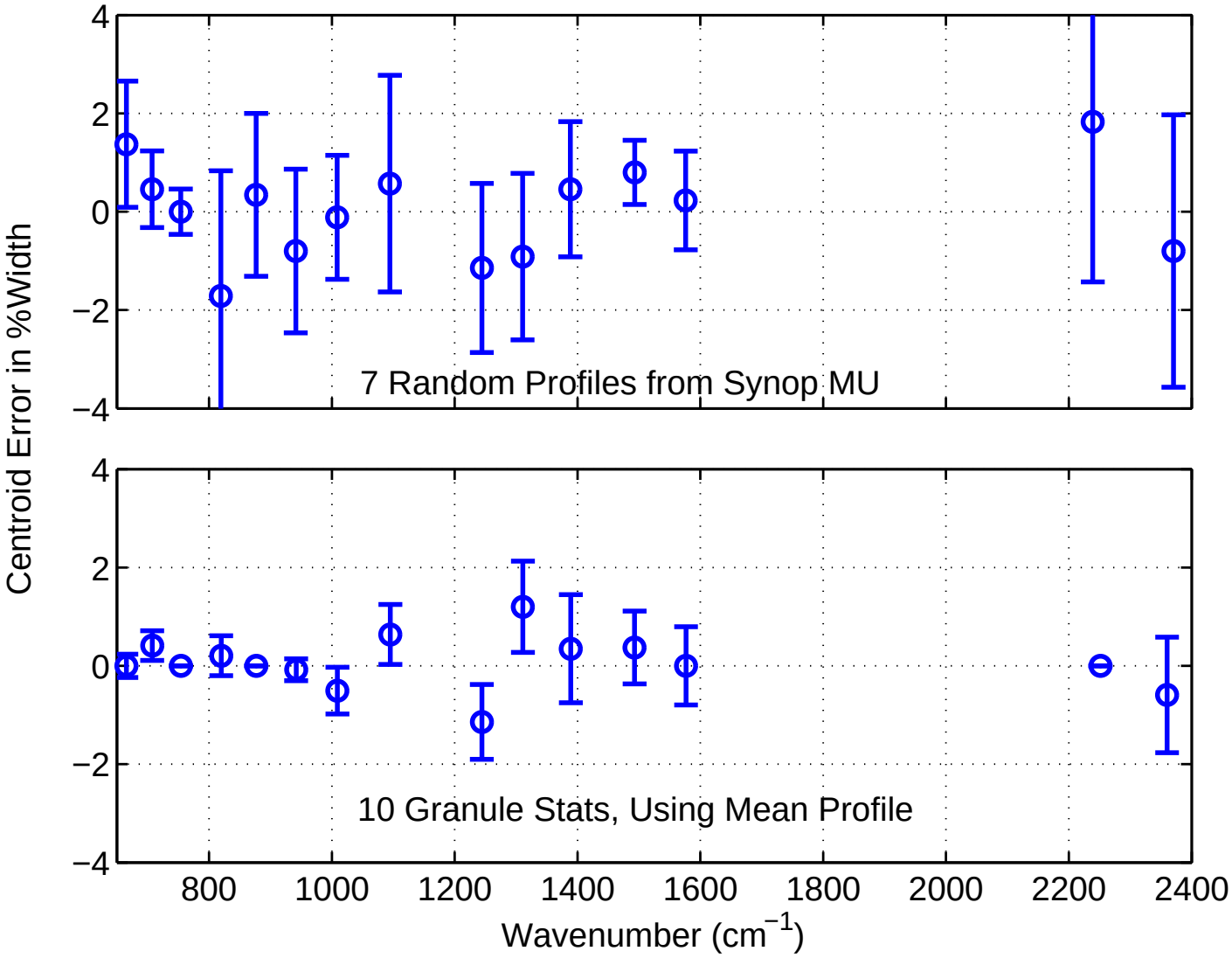
Obs vs Computed Correlations for ν=739 cm^{-1}



Spectral Calibration (before correct RTA available)

- Verify L1b provided frequency calibration set; (V2.2.0 didn't have L1b-determined frequency data, correct?)
- Provide UMBC with AIRS frequency calibration during Launch+2 to launch+3 for kCARTA radiance calculations.
- Two approaches:
  - Single granule: generate mean clear B(T), mean profile from ECMWF
  - Single profile: single clear B(T), ECMWF closest profile
- Generate mean obs-calc B(T) curves for each module for a range of SRF offsets and find the minimum per array. Need to fine tune if need more than a single offset/array.
- Most of the time taken in running kCARTA (once) - 15 minutes.
- As expected, using mean profile is more accurate.
- Software needs about 1-2 weeks to be "turn-key" at UMBC, plus some documentation

Results of Frequency Fit per Module

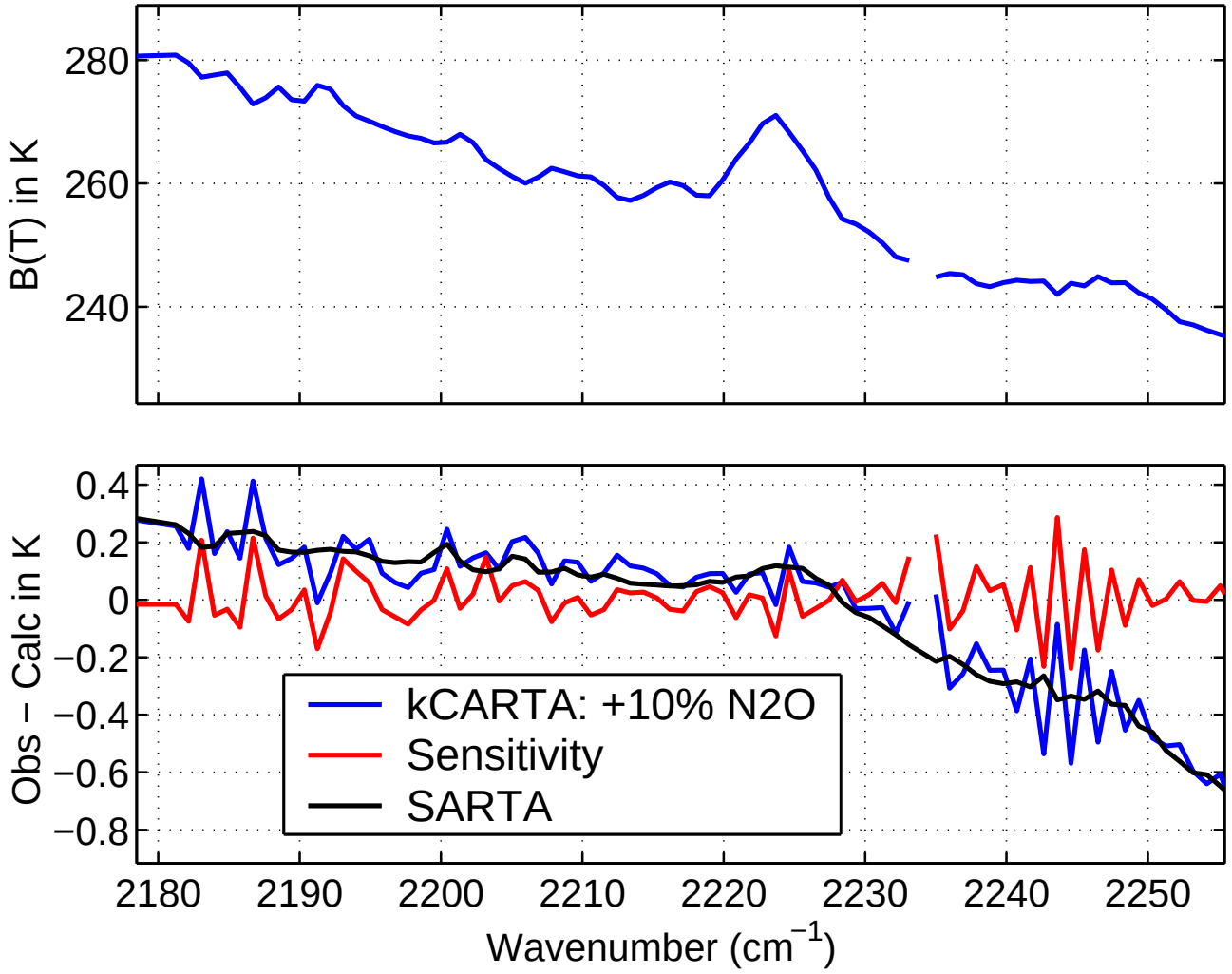


Verify SRF's in Orbit Same as in RTA: SRF Width

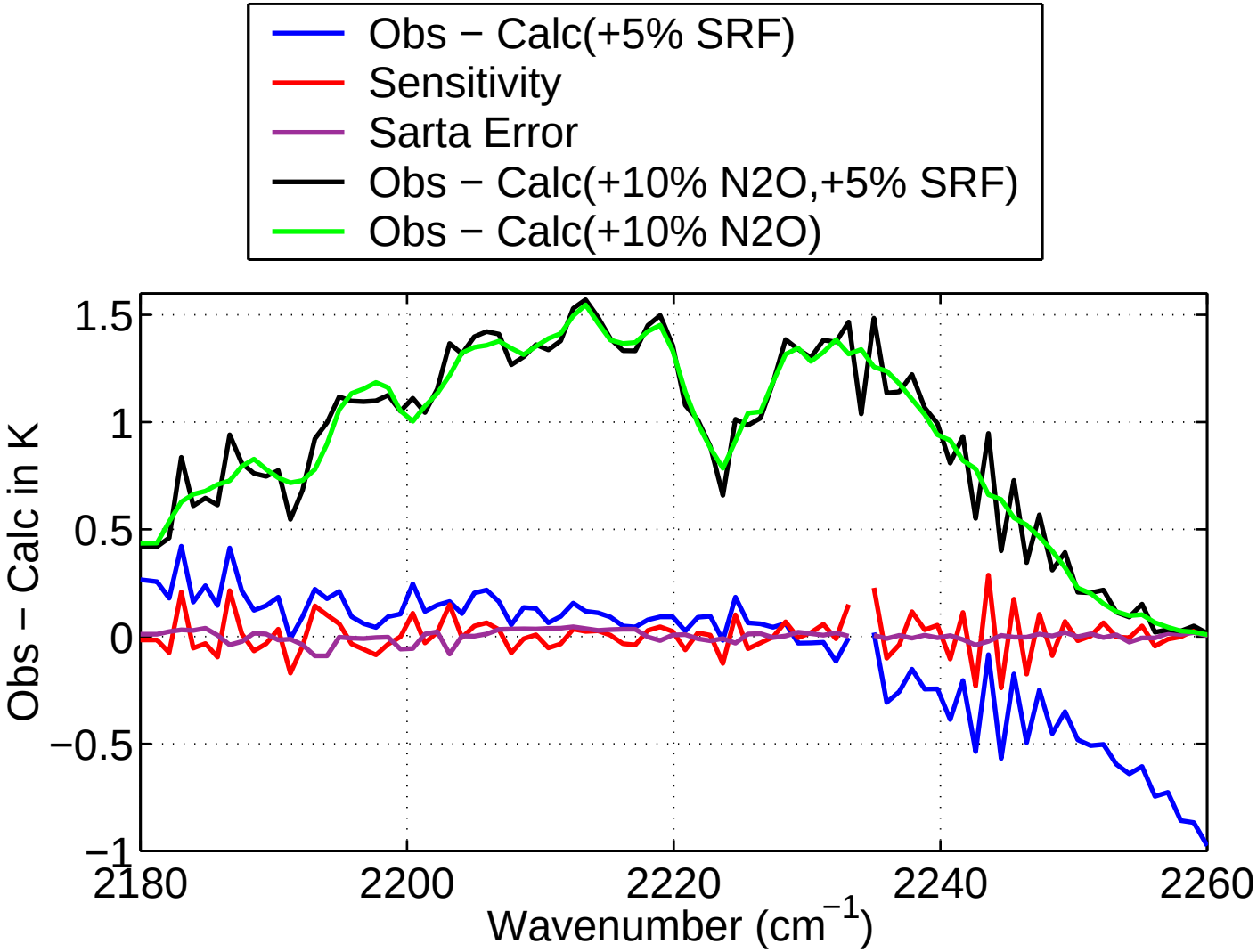
- Very difficult since uncertain temperature and water can mimic errors in SRF width.
- Requirement varies considerably with channel, nominally 1-5%
- Need to look at calibration data when AMA was de-focused.
  - What is relationship of SRF width to de-focus?
  - Can that relationship be determined from plate scale factor?
  - Has someone done this??
  - Low priority?
- During early validation, tests suggest that N_2O spectral region best suited for this test
- Sensitivity is quite low, chance of occurance low as well
- Used synoptic matchup-files (cleared) for analysis
- Software specialized since must change SRF width, low priority test that Scott Hannon can perform if needed.

SRF Width Sensitivity

Label Error: should be kCARTA: +5% SRF Width



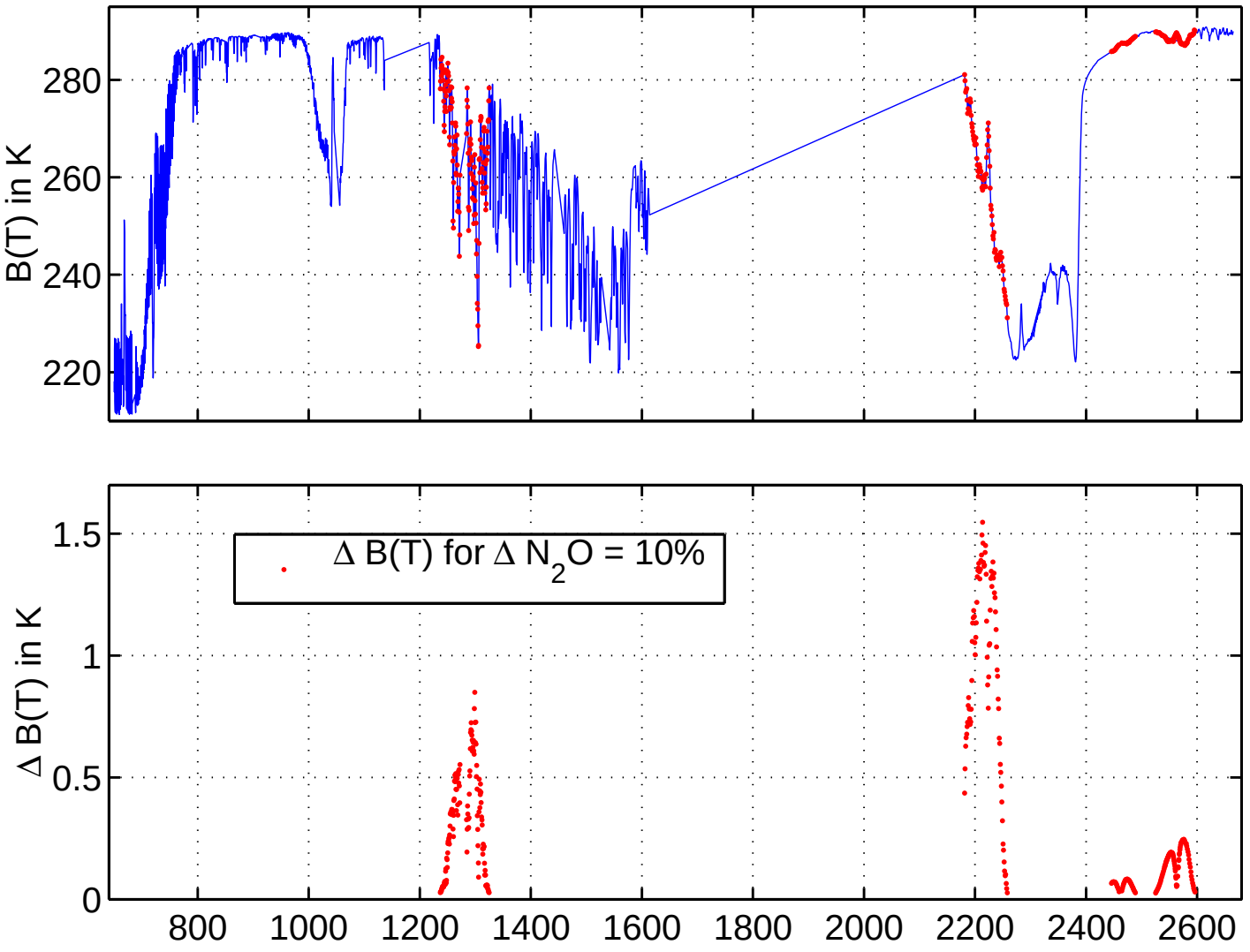
SRF Width Sensitivity #2



Verify the N_2O Abundance is Correct

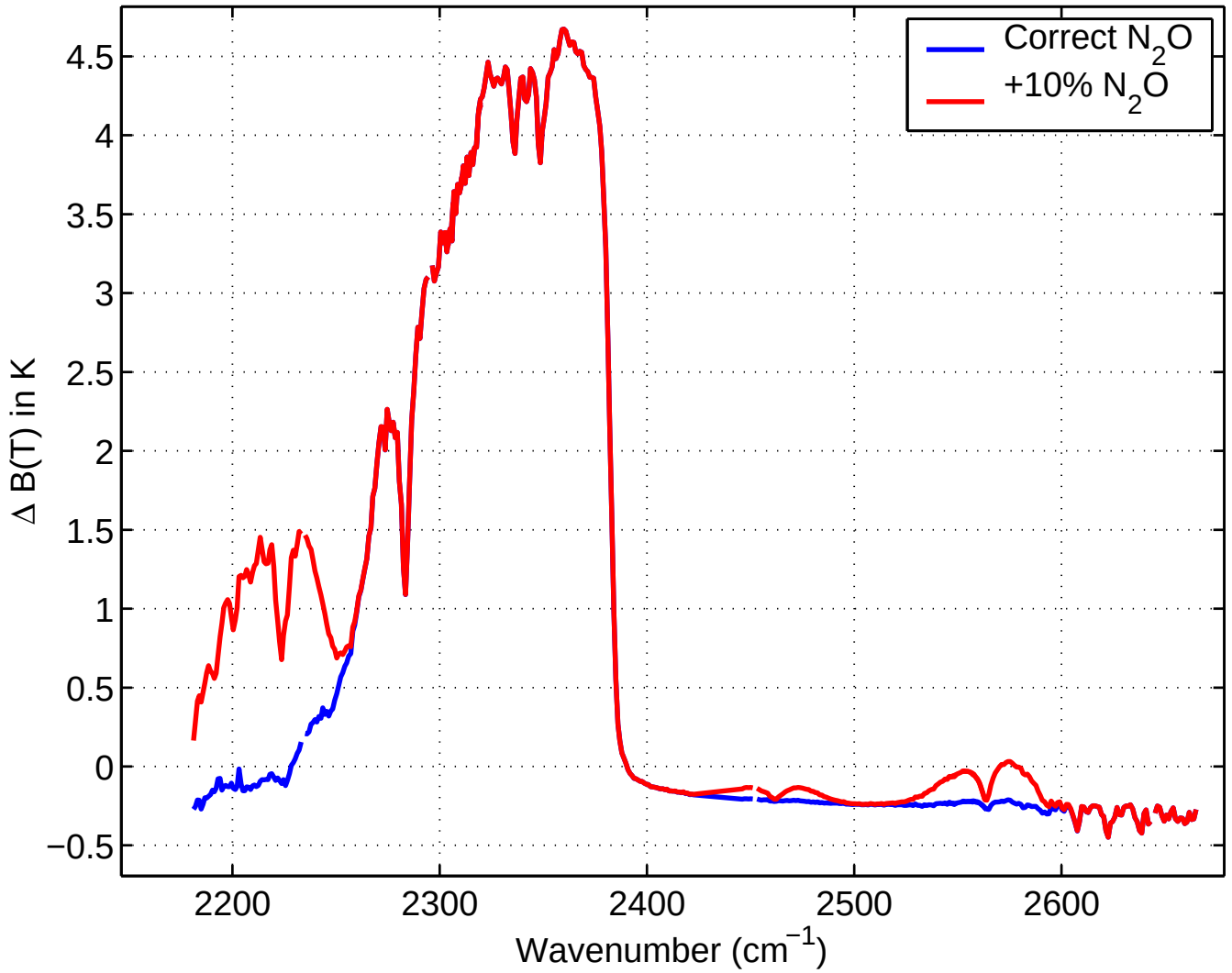
- Need to check abundances used for several RTA gases, but N_2O main interference gas in retrieval channels
- Used synoptic matchup-files with kCARTA to evaluate ability to detect incorrect N_2O column amount
- Lower troposphere variation maybe $\sim$1%, stratospheric much higher, but AIRS insensitive to N_2O there. Variability probably only a concern near 2200 cm^{-1}.
- Detection near 1% possible?
- Software almost ready, needs documentation

Sensitivity to N_2O



Retrieval of N_2O

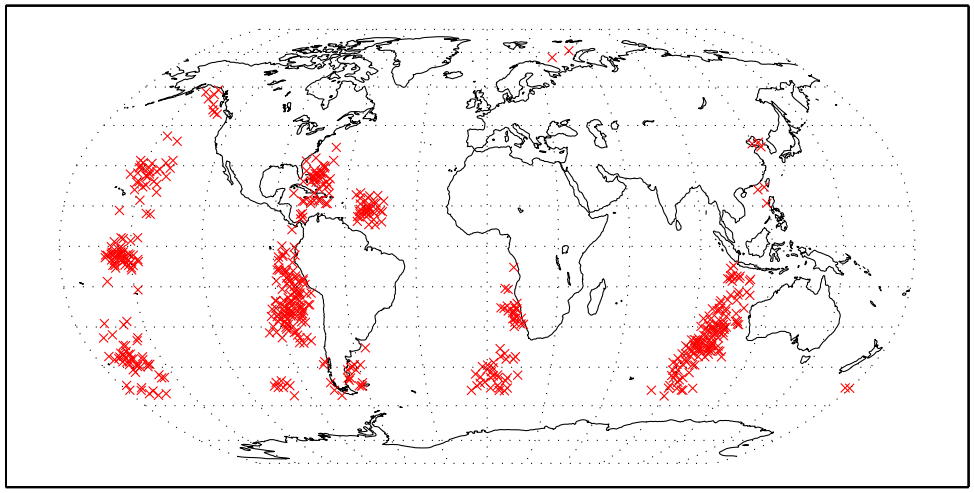
(Both curves are biases using the synoptic matchup files and ECMWF profiles)



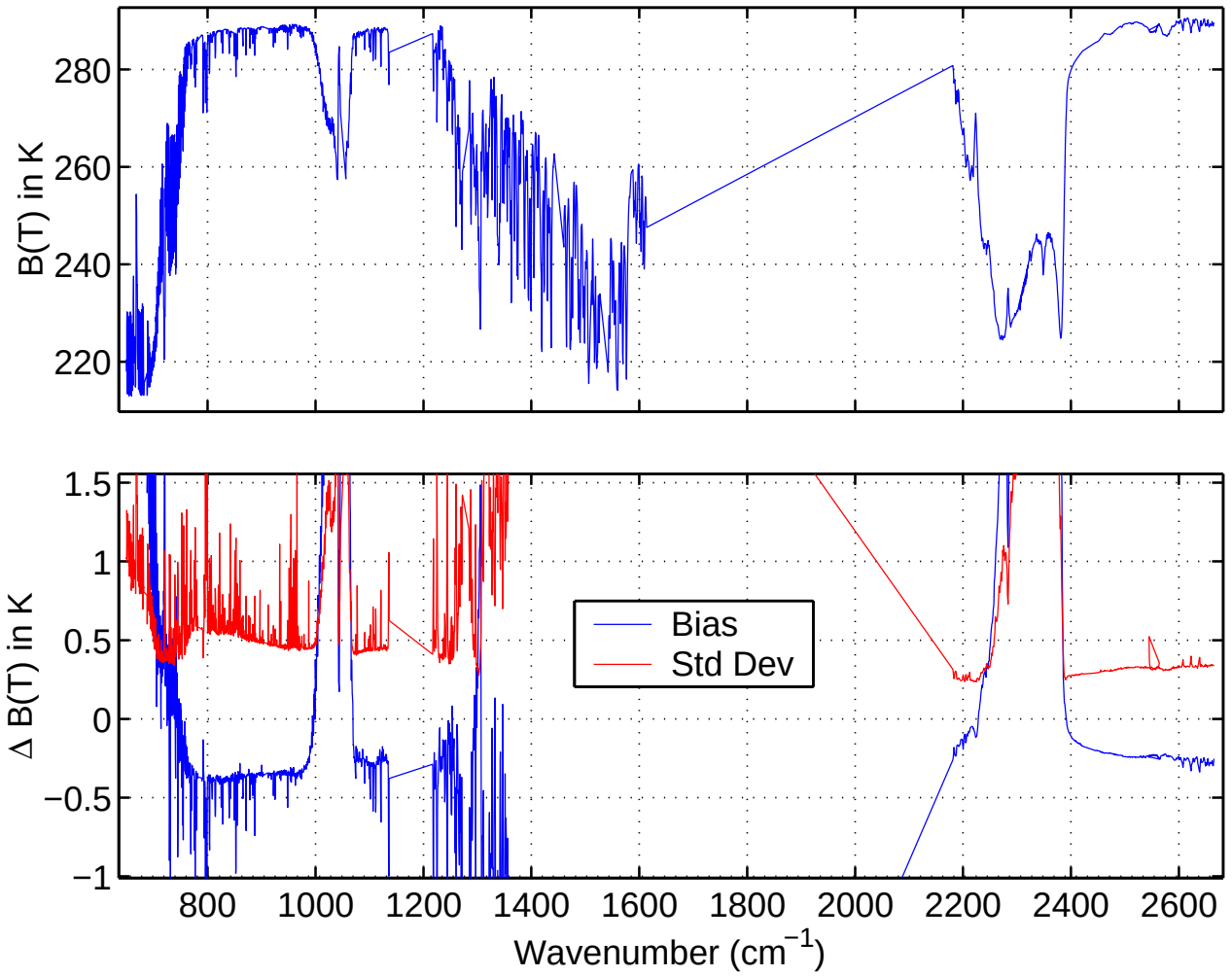
Evaluate Biases using ECMWF: kCARTA and SARTA

- Can do 1000+ profiles/day with kCARTA, sufficient for clear/night/ocean synoptic matchup
- Single granules might have up to 400 ECMWF grid points, could process several granules/day with kCARTA, more with subsetting
- Note: only used center FOV of matchup golfballs, picked warmest FOV
- Software in good shape, SARTA almost automated, kCARTA needs work on distributing to processor farm

Synoptic Matchup Locations

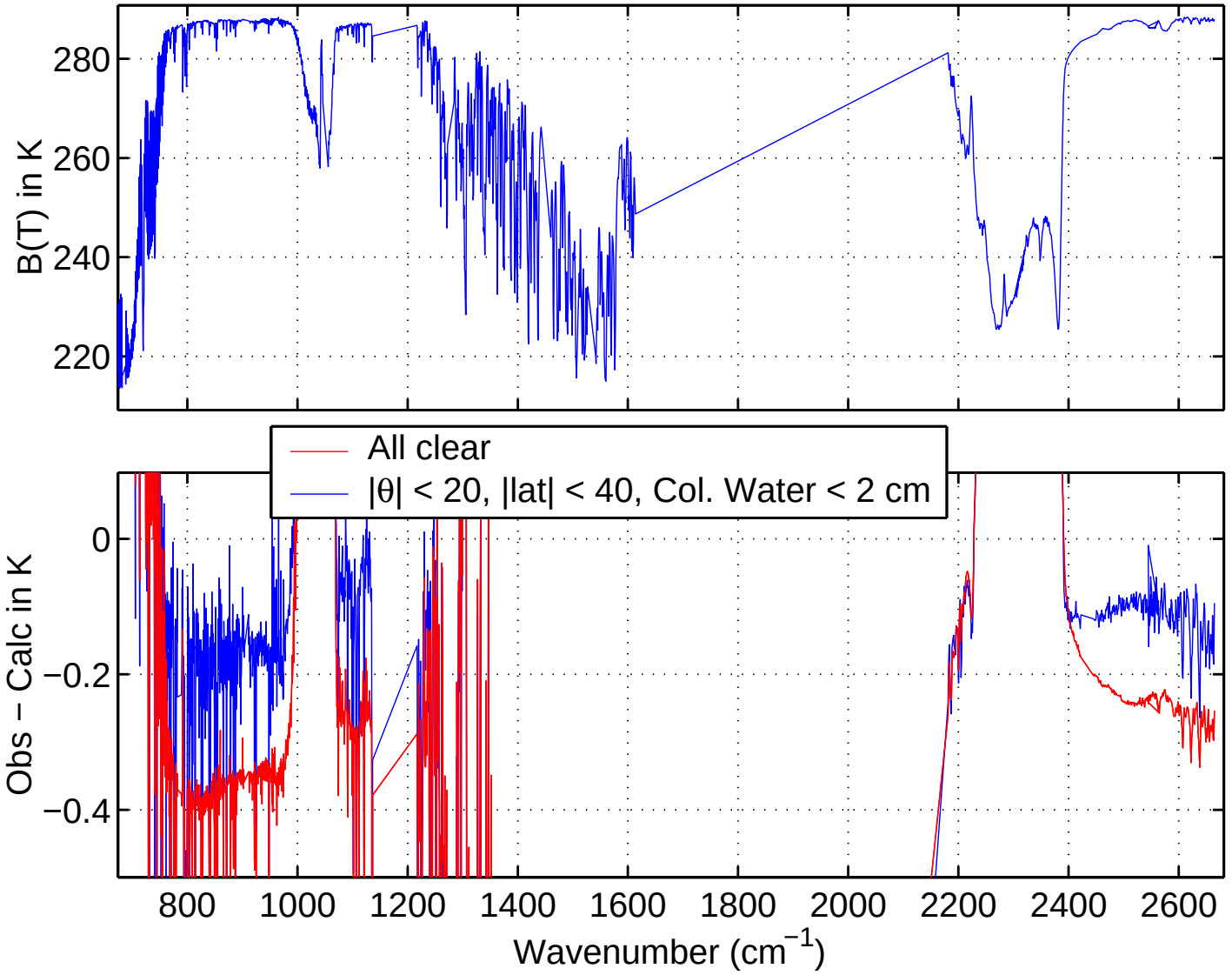


Synoptic Bias/Std Night/Ocean

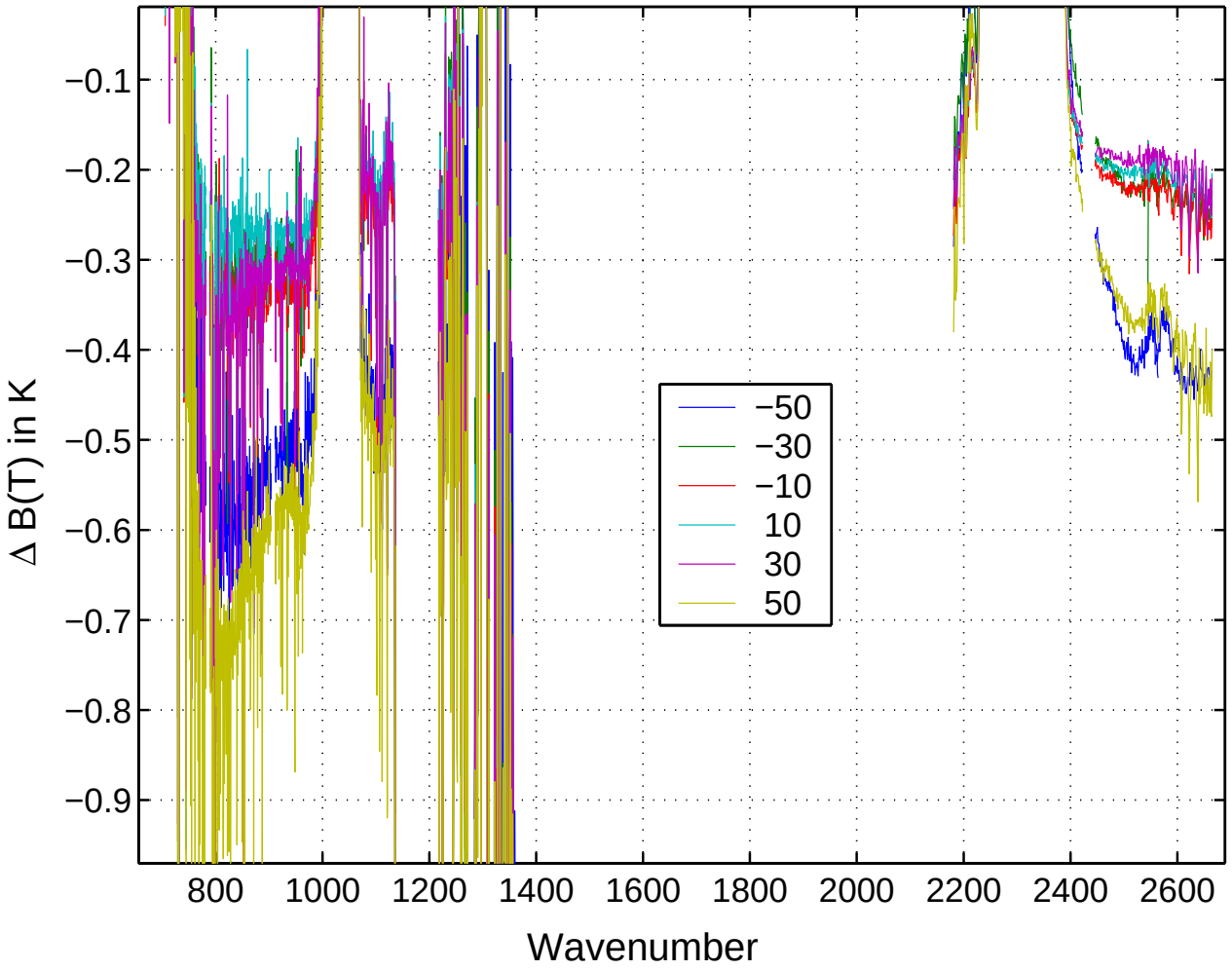


Shortwave window STD about 0.1K larger than noise

Synoptic Bias/Std Night/Ocean, Subsetted



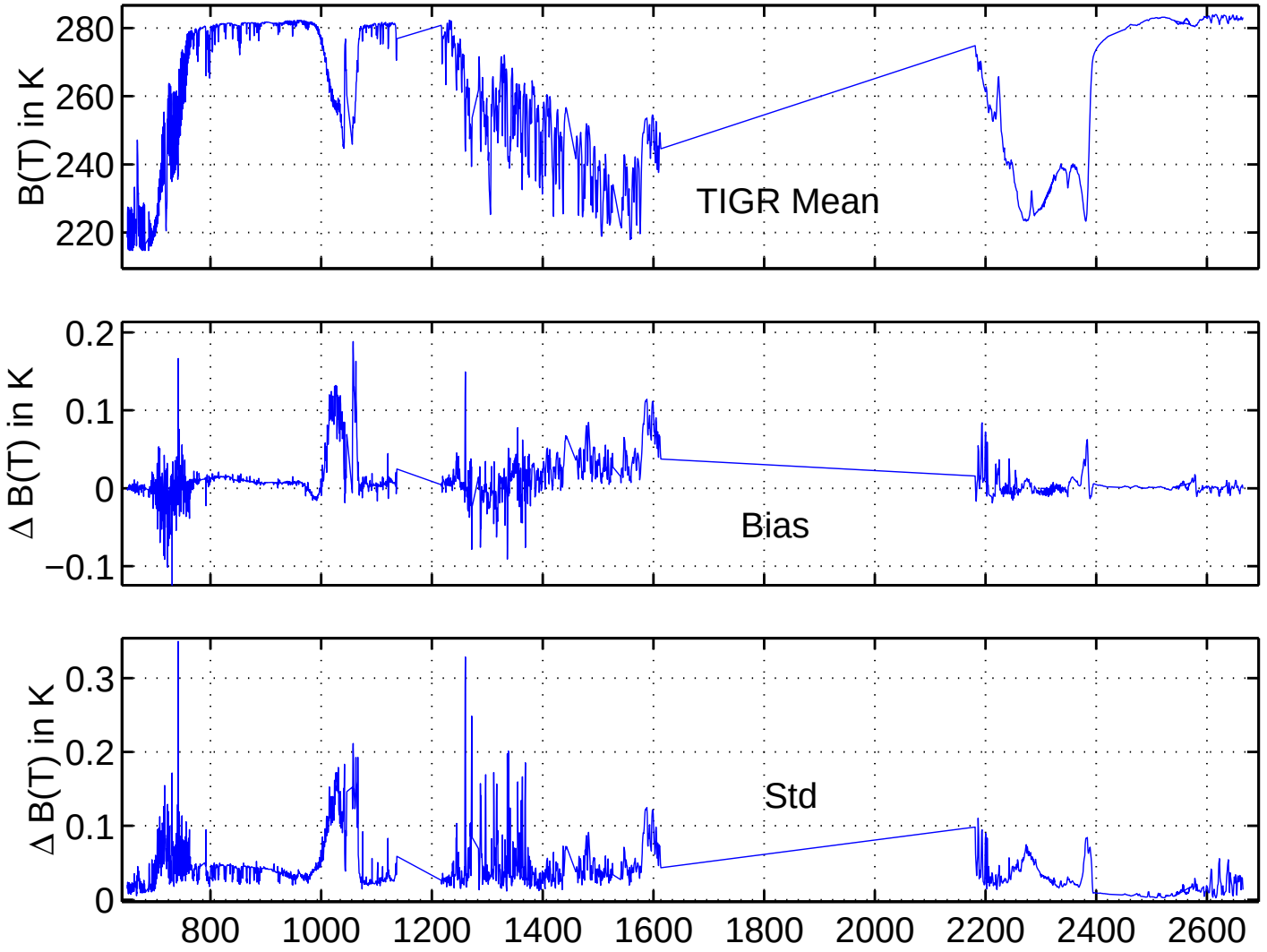
Synoptic Bias with Scan Angle



Low Temperature Radiometry Verification using AMSU Channels

- No progress
- Need to make sure we are running microwave forward model properly with RTP
- Hope to work jointly with MIT on this
- Need to work out schedule

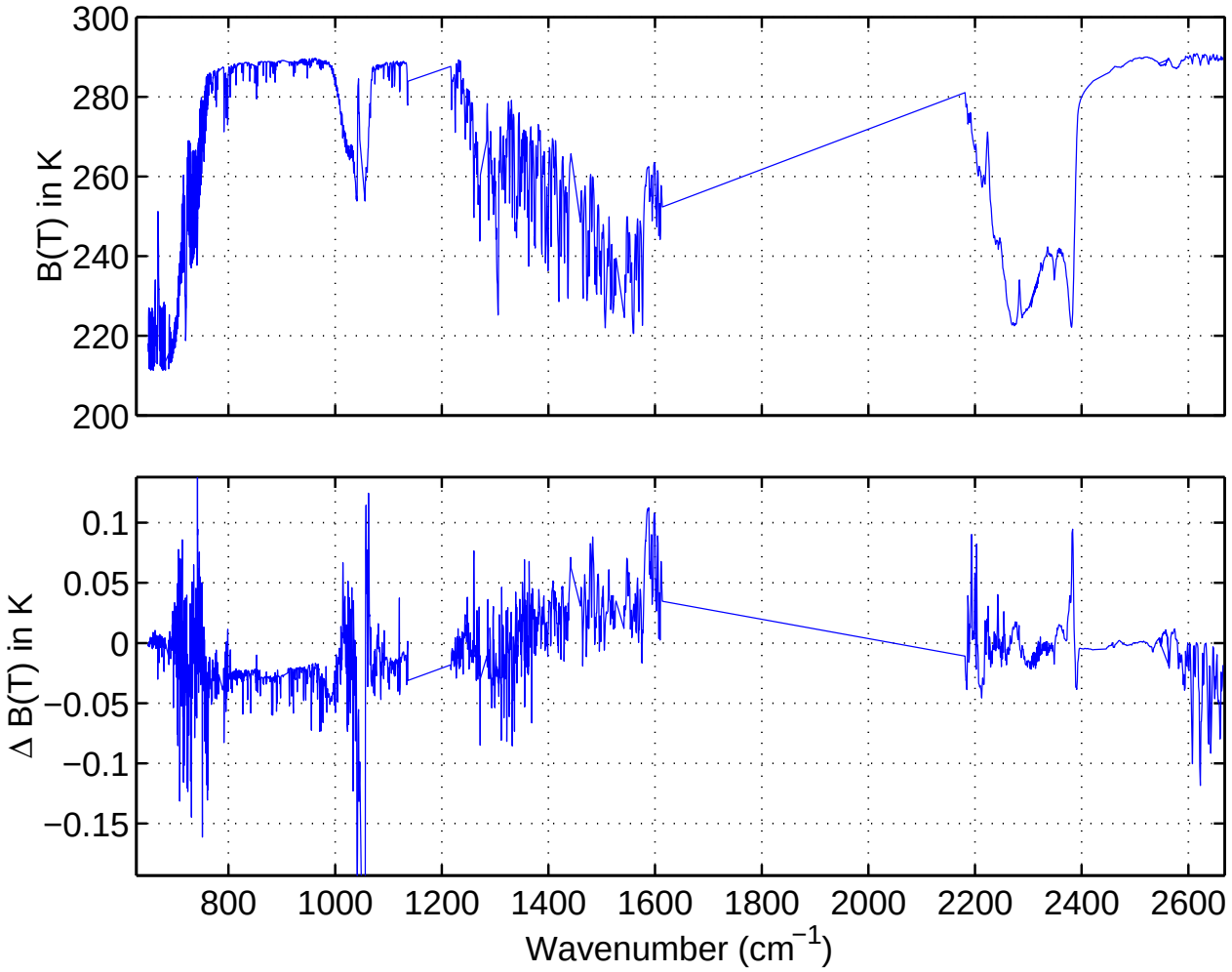
Fast Model Stats Using Independent Data Set (from TIGR)



Fast Model Stats Using Synoptic Matchups

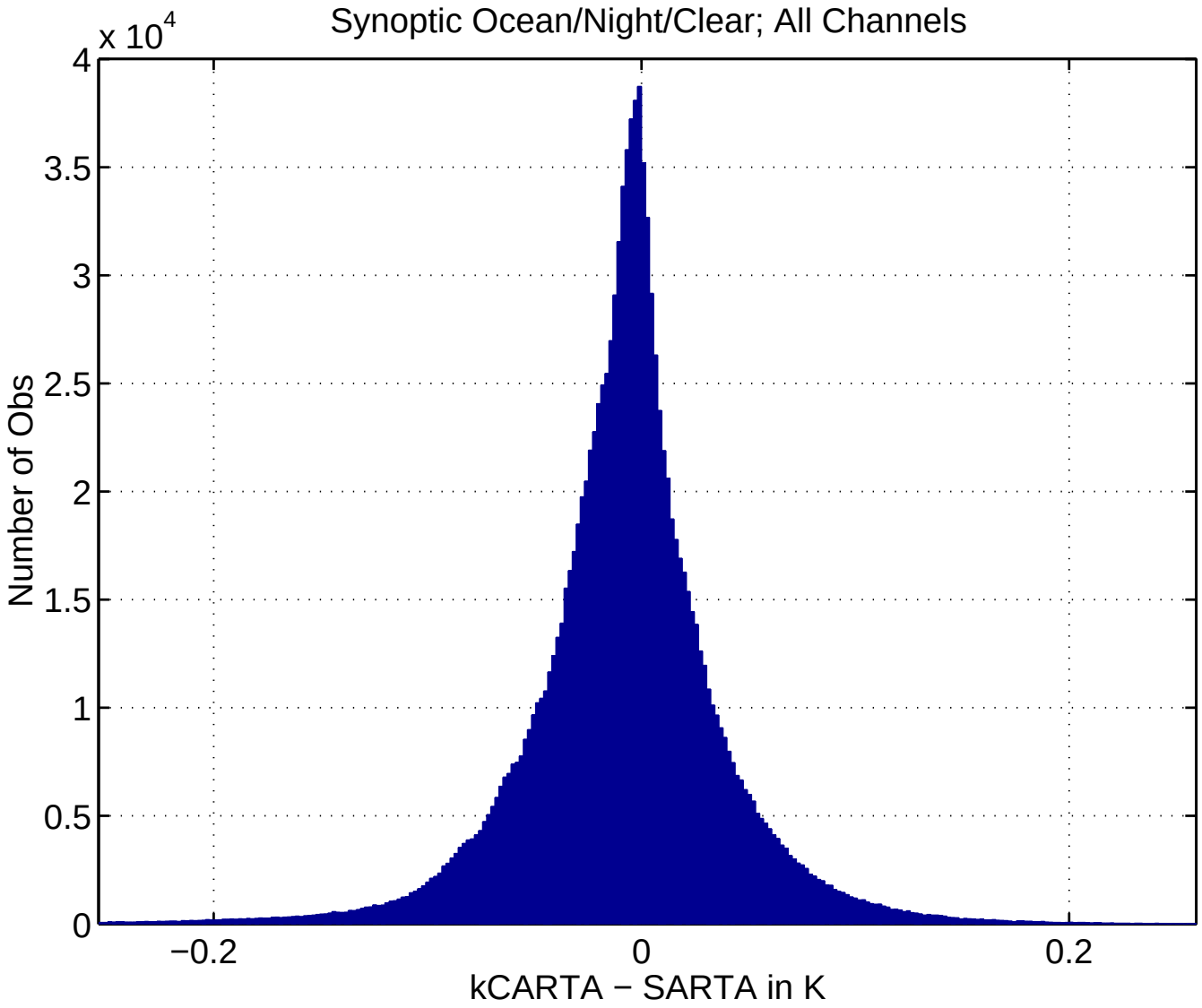
- Since we ran kCARTA for the synoptic matchups, we can compare to SARTA calcs.
- Helped us ensure that kCARTA and SARTA were treating all RTP fields consistently (they weren't at first)
- Uncovered issues with cld = 0 flag, default behavior if satellite height not set, solar zenith angle definitions, and SRF convolution issues (later).

kCARTA - SARTA Bias for Synoptic Matchups



Large ozone errors examined, histogram implies true bias error

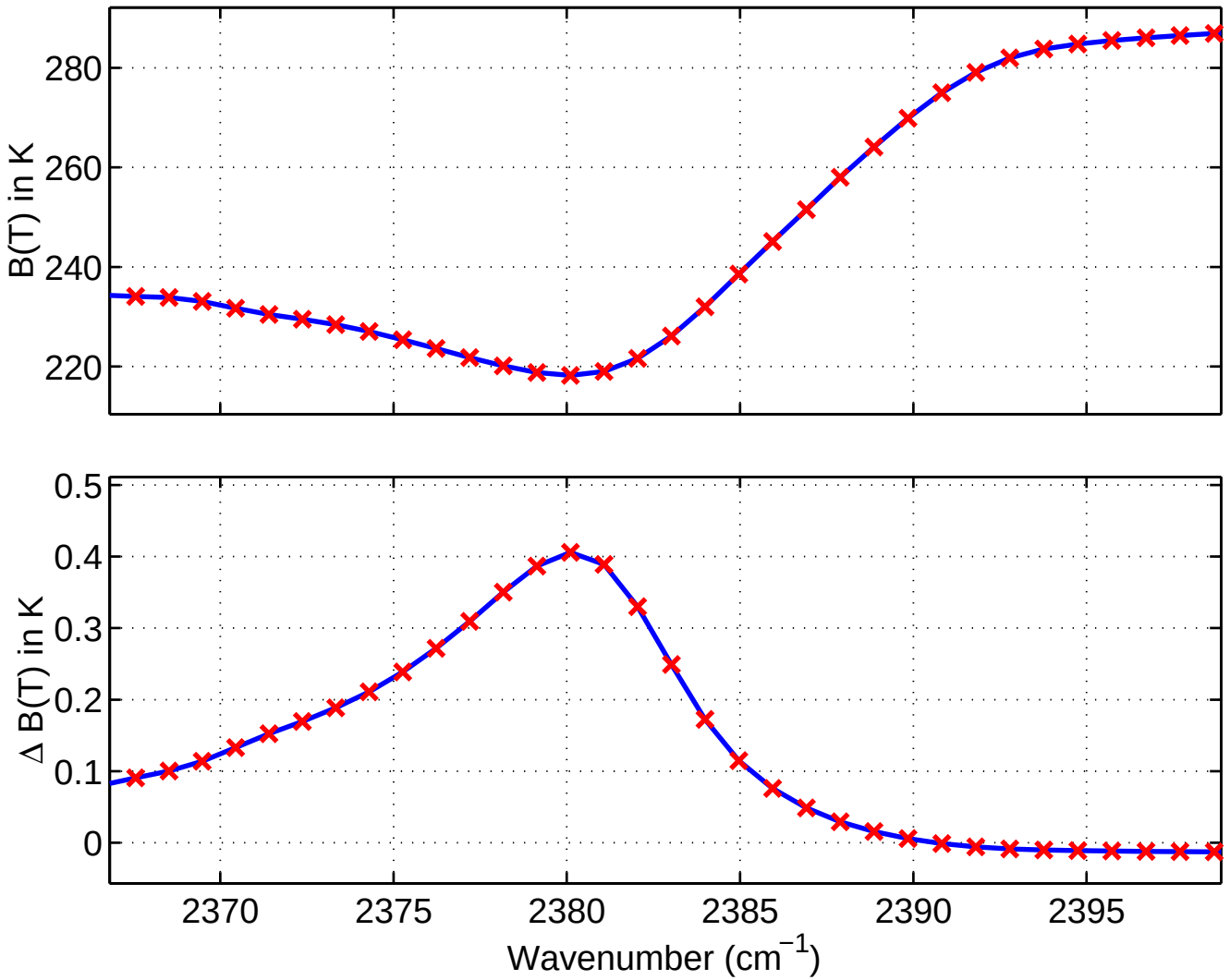
Histogram of kCARTA - SARTA Bias Errors, All channels/FOVS



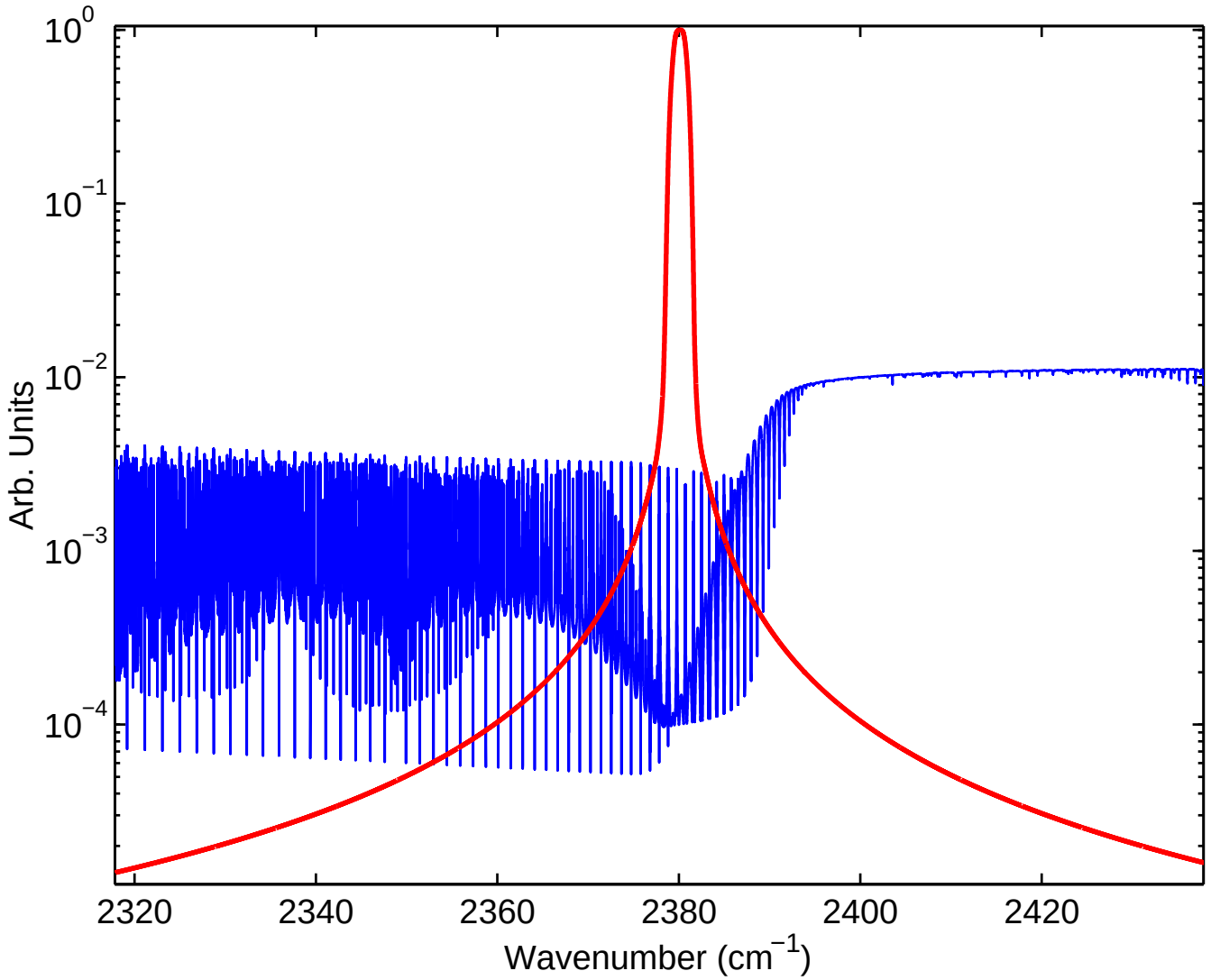
SRF Accuracy Issue

- Based on estimated accuracy of measured SRF's, our convolution routines cut off the SRF at 10^{-4} of SRF peak value.
- Estimates made using US Standard profile?
- Higher lapse rate profiles might need higher accuracy for a few channels in the 2380 cm^{-1} region
- We will re-visit SRF accuracy for these channels, which are mostly high altitude temperature sounding channels.
- Example of highly correlated forward model errors
- May have to avoid some of the coldest channels in this region

B(T) Differences for 10-4 vs 10-5 SRF Cut-Off



Monochromatic Radiance vs SRF Shape



Lessons Learned/To Do

- Had several imcompatabilities between kCARTA and SARTA, now fixed
- Probably will save level profile in RTP so kCARTA can add gases
- Will always need special codes to supplement profiles. klayers will only do simple adjustments using US standard atmosphere, etc.
- Use ECMWF to supplement profile until AIRS retrievals are available for high-altitude T/water.
- Probably will produce clear FOV RTP files at JPL to reduce data transfer.
- Re-visit sea surface emissivity (wider wavelength range)
- Install surface emissivity model (CERES?)
- Can we get a good emissivity*B(T_s) product before retrievals are fully operational?
- Big item for us: Improved water spectroscopy in latest HITRAN. Need to re-do kCARTA tables and forward model.
- Need to practice generation of new forward model anyway.